Health & Safety Benefits of Modern Off-grid Lighting

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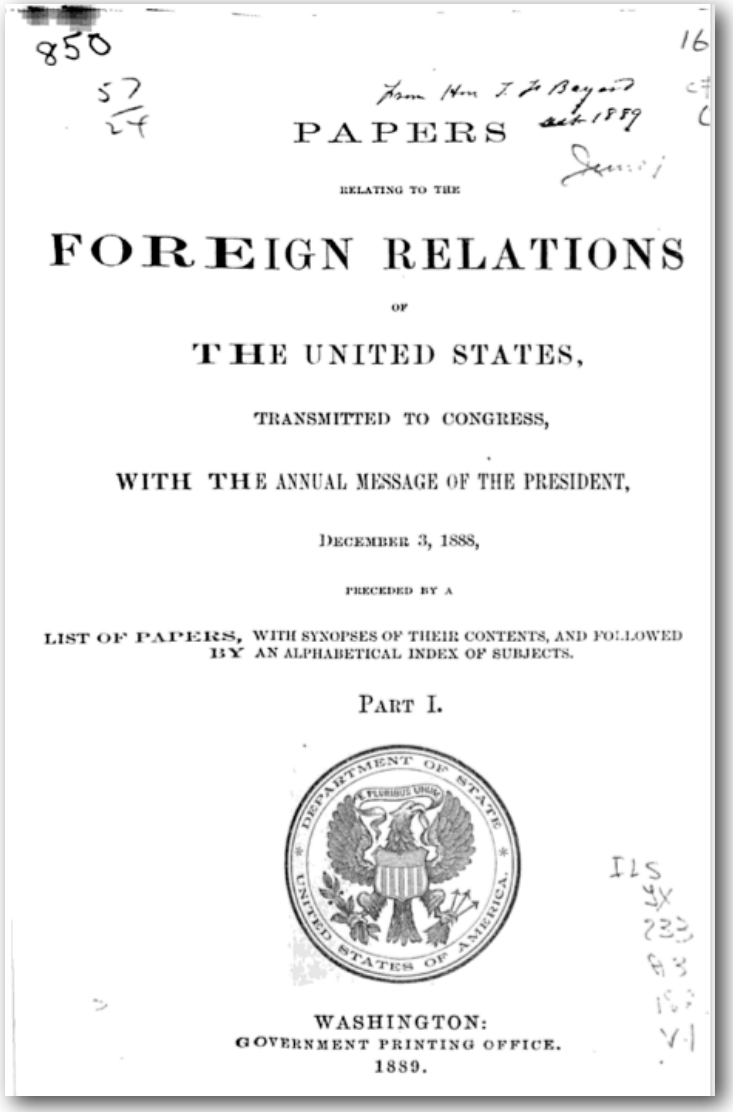
Context

- Sustainability and public health intertwine
- Co-benefits of energy savings can be more important than environment or economics
- Incomplete and inaccurate statements are often made about health and fuel-based lighting - there is no need to oversell!
- On the other hand, kerosene is often positioned as a “clean” fuel
- This is an old problem, only recently being embraced by the off-grid lighting community

An Old Problem…



PAPERS

RELATING TO THE

FOREIGN RELATIONS

OF

THE UNITED STATES,

TRANSMITTED TO CONGRESS,

WITH THE ANNUAL MESSAGE OF THE PRESIDENT,

DECEMBER 3, 1888,

PRECEDED BY A

LIST OF PAPERS, WITH SYNOPSES OF THEIR CONTENTS, AND FOLLOWED BY AN ALPHABETICAL INDEX OF SUBJECTS.

PART I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

Making Light off the Grid

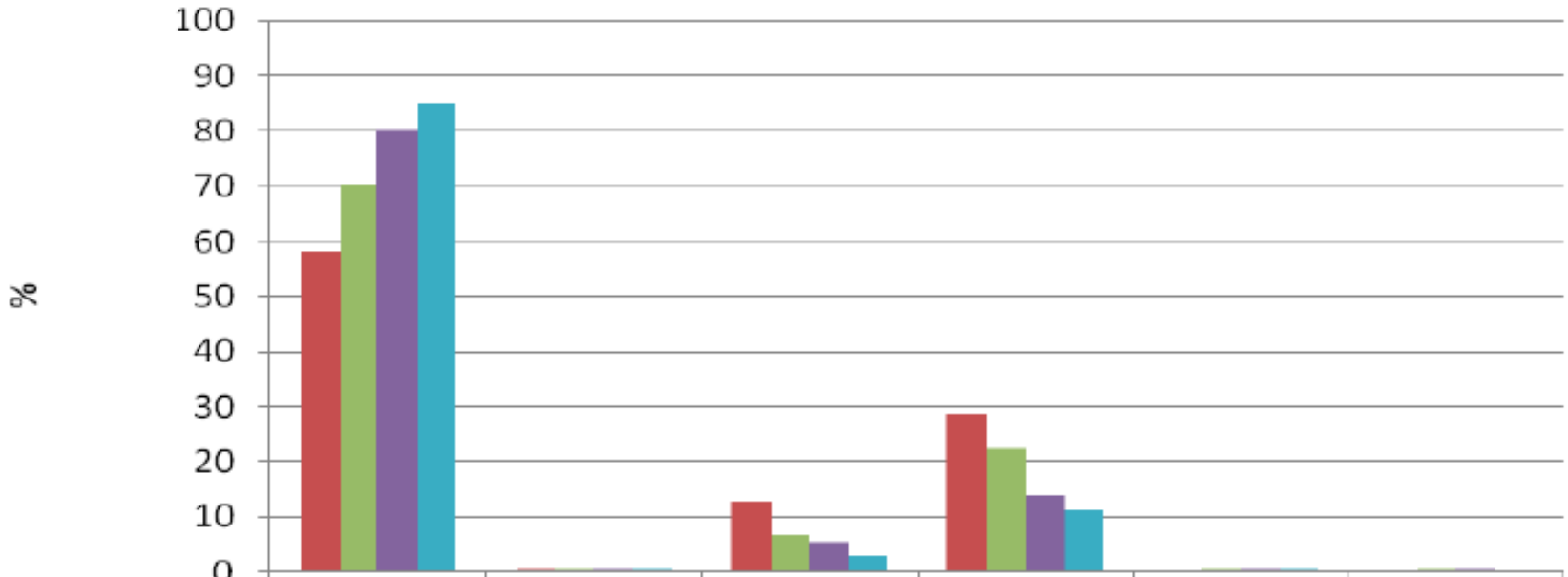







Kerosene Isn't Always the Dominant Lighting Fuel

South Africa (Census 2011)



	Electricity	Gas	Paraffin	Candles	Solar	Other
Census 1996	58,2	0,4	12,7	28,7	0	0,0
Census 2001	70,2	0,3	6,6	22,4	0,2	0,3
CS 2007	80,1	0,2	5,3	13,7	0,2	0,5
Census 2011	84,7	0,2	3,0	11,4	0,4	

85 Studies; 27 Countries

Issue	Reports	Countries	
House fires	11	6	Bangladesh, China, India, Nepal, Philippines, South Africa
Kerosene burns	16	7	Bangladesh, India, Mozambique, Nepal, Nigeria, South Africa, Sri Lanka
Kerosene explosions	17	4	India, Nigeria, Papua New Guinea, South Africa
Kerosene ingestion	28	18	Antigua and Barbuda, Barbados, China, Ghana, India, Iraq, Israel, Jamaica, Jordan, Kenya, Libya, Malawi, Malaysia, Nigeria, Pakistan, South Africa, Sri Lanka, Zimbabwe
Indoor air quality	4	1	Nepal
Visual health	7	8	Ethiopia, Ghana, Kenya, Nepal, Kenya, Nepal, Tanzania, Thailand, Zambia
Healthcare services	2	2	Nigeria, Tanzania
Total	**85**	**27**	

- Most studies focus on kerosene
- Most studies are limited to hospital intake data
- Some studies mix stove and lighting data

Lamp Burns

- **Worldwide**: More than 95% of deaths from fire and burns (all causes) occur in the developing world
  - mortality rate is 5x higher in low- and middle-income populations in Africa than in Europe
- **South Africa**: 200,000 people of all ages are injured or lose property each year due to kerosene-related fires
- **Southern India**: burns are #2 source of childhood injury-mortalities, with about half due to lamps
- **Bangladesh**: 23% of infant burns
- **Sri Lanka**: 40% of domestic burns are attributed to kerosene lamps, with 150-200 lives lost each year, and a cost of $1M
- **All studies reviewed**: 3% average death rate, many studies go quite a bit higher

House Fires

- **Philippines**: 3,000 people effected in a Philippine slum, killing 16
- **India**: 200 homes in 2010
- **Bangladesh**: 1,500 homes, killing 15
- **Nepal**: 1,200 of 1,500 homes in refugee camp, 12,000 homeless
- **South Africa**: 500 homes, killing 2, 2,000 homeless
- **Uganda:** One study: 70% of house fires due to kerosene lanterns
- **China**: 1,000 families displaced

Fuel Adulteration

nigerian Compass

Kerosene explosion burns Delta beauty queen

Dominic Adewole, Asaba
Monday, 18 June 2012 00:00
616 Hits

MONDAY, 18 JUNE 2012 00:00 | WRITTEN BY DOMINIC ADEWOLE, ASABA

The 2011 Most Beautiful Queen of Secondary Schools in Delta State, Miss Stella Ogbame, has been severely burnt by kerosene explosion.

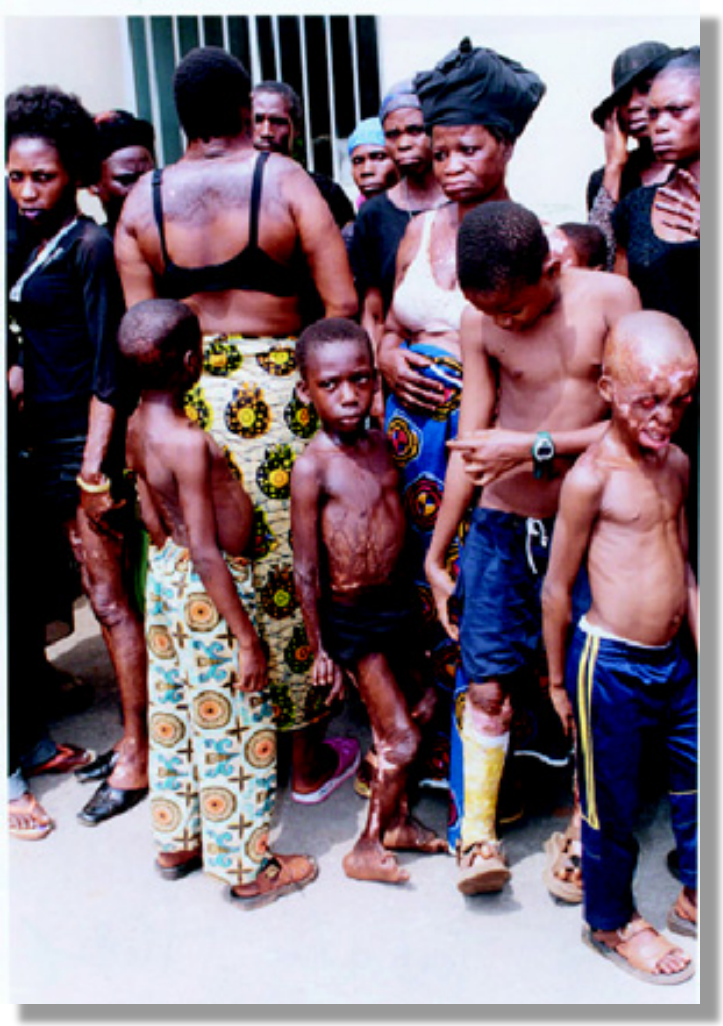
The beauty queen, who hails from Ada-Irri community, is between life and death at the Central Hospital, Oleh, Isoko South Local Government Area of the state.

The 18-year old queen, who has just concluded her final examinations and was waiting for her results, won the beauty pageant and became "Miss Future Light" of the oil rich state, the Nigerian Compass gathered yesterday, was another victim of Nigeria's epileptic power supply.

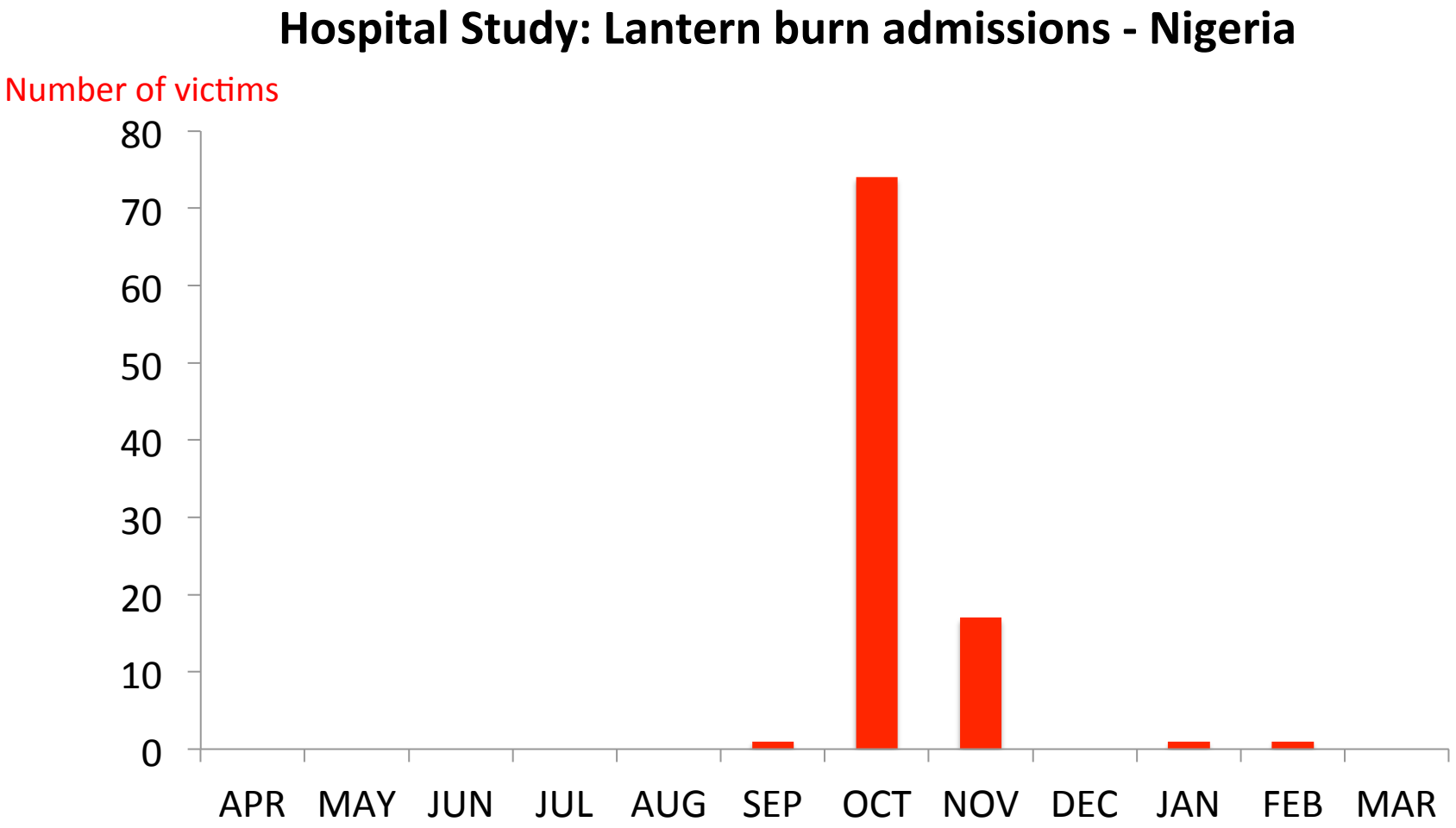
On the fateful night of the incident, the beauty queen had wanted to rescue her family members from darkness when she became a victim.

Fuel Adulteration

- Worst report: 2,500 victims in Nigeria's Edo region
- Nigerian hospitals: 1/3rd of burn cases
- Hospital capacity often exceeded
- Death rate averaged 24% in studies reviewed



Explosion Epidemics



Kerosene Ingestion

- Primary cause of child poisoning in developing world! (25-65% of all child hospital admissions)
- Kept in ordinary beverage bottles at floor level
- Risk is ironically compounded by lack of light
- 1ml can cause complications
- Pneumonia: 10-40% of cases
- Death in ~2-3% of cases

2-year old in hospital after drinking kerosene, Pakistan

Indoor Air Quality

- Almost all studies focus on wood: different exposures, different chemistry
  - 2M deaths and 1.4 billion illnesses – *not to be associated with lighting*
- Concerns: asthma & other respiratory ailments, TB, cataract, cancer....
- Lamps often located very close to people
- Emissions vary by fuel and by lamp type
  - Kerosene contains hundreds of compounds and varies widely in terms of chemistry and impurities
    - PM, Formaldehyde, NOx, CO, PAH, SOx

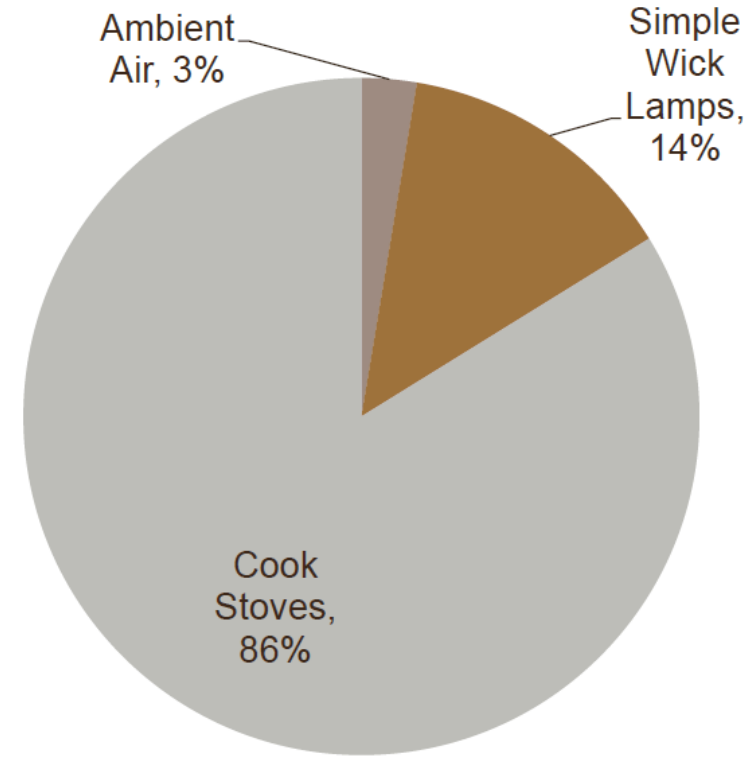
IAQ (continued)

- PM2.5 => 10x World Health Organization (WHO) standards
- TB: 1 study found women 9x more likely to develop TB when using lamps
- Other issues
  - Lead wicks
  - Radioactive Thorium in mantles

Cookstoves *vs.* Lanterns

- Different types and chemistry of pollutants
- Kerosene stoves have more efficient combustion than lamps
- Those not participating in cooking have relatively high exposure to lighting emissions

Particle Inhalation Risk



Poppendieck et al., 2010

Visual Health

- Lantern light levels are only 1/10th to 1/100th of those recommended in industrialized countries
- Near-sightedness, cataract; other complaints
  - Night fishermen: reduced vision after exposure to long hours of bright mantle lamps
  - School performance; worker performance
- Impaired vision and visibility are in itself unsafe

Delivery of Health Services

- Many clinics have light only intermittently
  - Patients won't seek care at night (clustering at day); often required to bring kerosene to clinic
  - Creates difficulty sterilizing equipment
  - Patients often told to bring own lamps/kerosene
- Child delivery
  - 99% of maternal mortalities occur in Dev World.
  - Doctors using cell phones as torches, e.g. during child delivery

Solutions: Underlying Causes

- Lack of product safety labeling or warnings. Illiteracy (inability to receive communications about risk)
- Overcrowding (contributes to rapid spread of fires and peoples' proximity to lantern emissions)
- Corruption and fuel subsidies (fuel adulteration)
- Unsupervised children, poverty (inability to afford child-safe containers for fuels)
- Cultural practices (e.g., keeping lamps next to young children while sleeping to ward off evil spirits)
- Ineffective or counterproductive folk remedies (e.g., inducing vomiting after kerosene ingestion), plus delay, unwillingness, or inability to seek professional care

Women and children disproportionately impacted

Gender-Age Dimensions

- Indoor Air Quality
  - Women and children spend more time indoors
  - Men and children not participating in cooking receive larger share of overall exposure from lamps
- Burns
  - Bangladesh: Kerosene lamps 23% of infant burns
  - Nigerian adulteration study: 3:1 women and 2:1 children
  - Adulteration injuries affect children and women most
- Ingestion
  - Almost all victims are children (average age ~1-2 years)

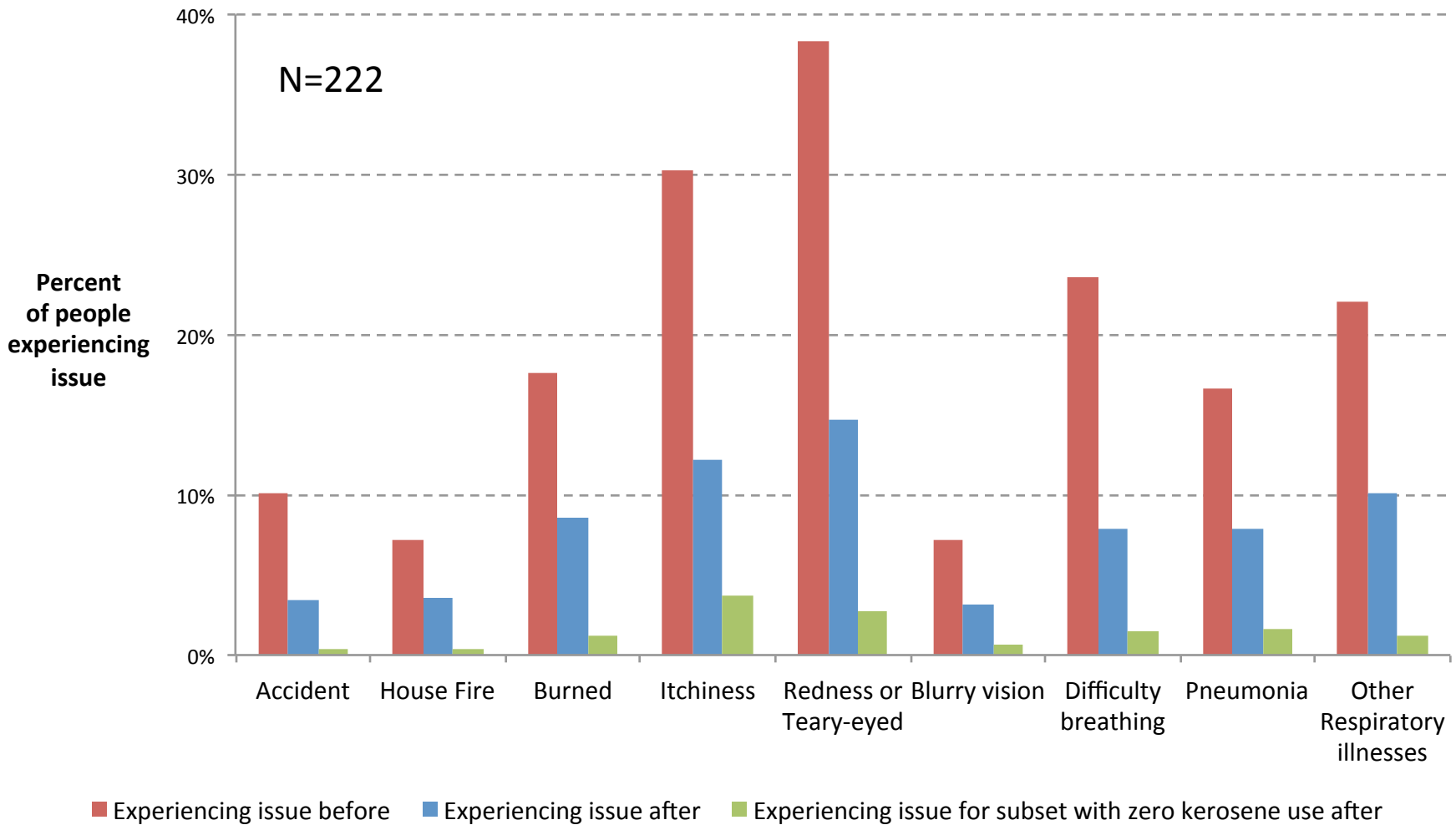
Solutions: Strategies

- Fill information gaps
  - Need larger studies (hospital-only data is limiting)
  - More information on emissions & risks by fuel
  - Educate (1 in 4 perceive risk, less in some areas)
- Indoor air quality standards
- Fuel handling regulation/oversight/penalties
- Address subsidies
- Better lighting (which of course is not perfectly free of health questions, but net health benefits are significant)

Solutions: Evidence

- Rural clinics
  - 30 rural clinics (Tanzania)
    - reduced infection rates
    - more people sought care, and sooner
    - more safe-baby deliveries and better outcomes for mothers
  - 26 clinics (Nigeria)
    - Better blood-banking; better morale
- Factories in Thailand – less eye strain
- Two studies in Philippines – reduced symptoms

Philippines: Reducing Symptoms



Targeting Interventions

- Slum fires
- Children drinking kerosene
- Fuel adulteration
- Clinics

Source: Paraffin Safety Association of Southern Africa

Continue the Discussion on LuminaNET.org